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(54) Spinning process for the preparation of high thermoweldability polyolefin fibers.

(57) Disclosed are polyolefin fibers, for the preparation of nonwoven fabrics, prepared by using dies having a real or equivalent output diameter of the holes greater than or equal to 0.5 mm, with the proviso that for fibers having a count greater than or equal to 4 dtex, the ratio of the said output hole diameter to the count is greater than or equal to 0.06 mm/dtex.

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The present invention relates to a spinning process for the preparation of thermoweldable polyolefin fibers, in particular polypropylene based fibers, suitable for the preparation of nonwoven fabrics.

Said nonwoven fabrics are particularly suitable for uses requiring considerable softness and tear resistance, as is the case with coverstock for diapers and sanitary wear, which are made from low count fibers, generally ranging from 0.2 to 5 dtex, or with also membranes, made from fibers having a count between 3 and 10 dtex. The fundamental requirement of polyolefin fibers for nonwoven fabrics is that they must bond to each other by means of the joint action of temperature and pressure on which the hot calendering processes are based. This characteristic, called "thermoweldability", is not always present in polyolefin fibers, or at least not in the same degree. In fact basically thermoweldability depends on the type of polyolefin being span, the additives it contains, the type of process and the spinning conditions used.

Published European patent application 391438 describes polyolefin compositions suitable for spinning and characterized by the presence of stabilizers selected from organic phosphites and/or phosphonites, HALS (Hindered Amine Light Stabilizers) and optionally phenolic antioxidants.

The same patent application describes thermoweldable fibers obtained from the above mentioned stabilized polyolefin compositions by conventional spinning processes, in particular processes for the production of staple fibers. In this case the good levels of thermoweldability shown in the examples are due to the selection of the stabilizers. In the above mentioned examples fibers having a count ranging from 1.9 to 2.2 dtex are prepared by using a typical "long-spinning" apparatus (characterized, among other things, by high fiber-winding speed) equipped with a die having holes with 0.4 mm diameter.

Using a die whose holes have a small diameter (less than or equal to 0.4 mm) to produce low count fibers is typical of both the above mentioned long-spinning apparatus, as well as the "short- spinning" apparatus both used for producing staple fibers, and of the spun-bonding machines, because it enables high production levels to be obtained.

In fact, the smaller the diameter of the holes, the higher the numbers of holes in the die, which means more fibers per unit of time. This is the reason why in the art the use of dies with diameters of the holes greater than 0.4 mm is limited to the production of high-count fibers (higher than 5 dtex).

Now it has surprisingly been found that, both in the production of staple fibers and in the spun-bonding process, the use of dies with holes having diameters greater than or equal to 0.5 mm results in a marked increase of the thermoweldability of the fibers, provided that, for fibers having a count greater than 4 dtex, the ratio of hole diameter to the count is high enough.

Accordingly, the present invention provides a process for the preparation of thermoweldable fibers having preferably a count ranging from 0.2 to 10 dtex, more preferably from 0.5 to 3 dtex, where the dies used have a real or equivalent output diameter of the holes greater than or equal to 0.5 mm, particularly ranging from 0.5 to 2 mm, with the proviso that for fibers having a count greater than or equal to 4 dtex, the ratio of the said output hole diameter to the count is greater than or equal to 0.06 mm/dtex, preferably greater than or equal to 0.08 mm/dtex, more preferably greater than or equal to 0.1 mm/dtex.

As used herein, "output diameter of the holes" is the diameter of the holes at the outside surface of the die, i.e., on the front face of the die from which the fibers exit. Inside the thickness of the die, the diameter of the holes can be different from the diameter of the holes at the output. The "equivalent output diameter of the holes" refers to instances where the hole is not round, in which case, for the purpose of the present invention, one considers the diameter of the ideal circle having an area equal to the area of the output hole, which corresponds to the above mentioned equivalent diameter.

As previously stated, the process of the present invention can be carried out by using both long-spinning and short-spinning apparatuses for the production of staple fibers, and spun-bonding apparatuses.

Long-spinning apparatuses normally comprise a first spinning segment where the fibers are extruded and air-cooled in a quenching column. Subsequently, these fibers go to the finishing steps during which they are drawn, crimped-bulked and cut. Generally, the above mentioned finishing steps are carried out intermittently with respect to the spinning, in a specific section where the fiber rovings are gathered into one single roving having a total count ranging from 100 and 200 kilotex. Said roving is then sent to drawing, crimping-bulking and cutting apparatuses which operate in sequence at a spinning speed ranging from 100 to 200 m/min. In other types of long-spinning apparatuses the above mentioned finishing steps are carried out in sequence with the spinning step. In this case the fibers go directly from the gathering to the drawing rollers, where they are drawn at a somewhat contained ratio (not greater than 1.5). Subsequently, they are gathered in rovings with a count of about 5 kilotex, then subjected to crimping-bulking and cutting at a speed comparable with that of the spinning.

Moreover, the long-spinning apparatuses allow for a better control of the process parameters compared to the control one has with the short-spinning apparatus. The process conditions which are generally adopted when using the long-spinning apparatuses are the following:

- hole flow rate >0.2 g/min;
- fiber-gathering speed ≥ 500 m/min;
- space where the fibers cool off and solidify after exiting the die >0.50 m.

The above mentioned conditions can also be used in the process of the present invention when the operation is carried out with the long-spinning apparatus and the dies used are the ones described above.

Preferably one operates within the following time ranges:

- hole flow rate from 0.15 to 1.0 g/min, preferably from 0.2 to 0.5 g/min;
- fiber-gathering speed ranging from 500 to 3500 m/min, preferably from 600 to 2000 m/min.

Moreover, it is preferable that the draw ratio be from 1.1 to 4.0.

For further details on the long-spinning apparatuses reference is made to Friedhelm Hauser "Plastics Extrusion Technology", Hauser Publishers, 1988, chapter 17.

It has been found that thermoweldability of staple fibers improves as the fibers gathering speed decreases. In particular, in the case of staple fibers, the process of the present invention is particularly advantageous when the short-spinning apparatuses are used, said apparatuses being characterized, among other things, by low fiber-gathering speeds (less than 500 m/min).

The above mentioned short-spinning apparatuses allow for a continuous operation, since the spinning speed is compatible with the drawing, crimping and cutting speeds, and due to their simplicity and reduced overall volume, these apparatuses are more economical than the long-spinning ones and suited for small scale productions. However, up until now short-spinning apparatuses did not allow one to obtain staple fibers having good thermoweldability values (higher than 2.5 N, for example, according to the measuring method described in the examples). The process of the present invention, therefore, assumes particular importance when short-spinning apparatuses are used, because it solves the problem of producing thermoweldable staple fibers even when operating with said apparatuses.

The process conditions which are best suited to be used according to the present invention using short-spinning apparatuses are the following.

The hole flow rate ranges from 0.005 to 0.18 g.min, preferably from 0.008 to 0.070 g/min, more preferably from 0.010 to 0.030 g/min. The fiber gathering speed ranges from 30 to 500 m/min, preferably from 40 to 250 m/min, more preferably from 50 to 100 m/min. The draw ratios range from 1.10 to 3.50, preferably from 1.20 to 2.50. Moreover, the fiber cooling and solidification space at the output of the die (cooling space) is preferably greater than 2 mm, more preferably greater than 10 mm, in particular from 10 to 350 mm.

Said cooling is generally induced by an air jet or flow. Therefore, the cooling space is the distance between the die and the above mentioned air jet or flow.

Finally, according to the present invention it is preferable that the draw temperature be lower than 100 °C, in particular it should range from 15 °C to 50 °C. For further details on the short-spinning apparatuses reference is made to M. Ahmed, "Polypropylene fibers science and technology", Elsevier Scientific Publishing Company (1982) pages 344-346.

The spinning temperature for the above long-spinning and short-spinning apparatuses generally ranges from 240 °C to 310 °C, preferably from 270 °C to 300 °C.

The equipment used in the process of spun-bonding normally includes an extruder with a die on its spinning head, a cooling tower, and an air suction gathering device that uses Venturi tubes.

Underneath this device, that uses air speed to control the fiber gathering speed, the filaments are usually gathered over a conveyor belt, where they are distributed forming a web for heat welding in a calender.

According to this invention, when using typical spun-bonding machinery, it is convenient to apply the process conditions that follows.

The hole flow rate ranges from 0.1 to 2.0 g/min; preferably from 0.2 to 1.0 g/min.

The space where fibers cool and solidify after leaving the die (the cooling space) is preferably greater than 2 mm, more preferably greater than 10 mm and in particular in the range between 10 and 350 mm.

The fibers are generally cooled by means of an air jet or flow. The cooling space is the distance between the die and this air jet or flow.

The spinning temperature is generally between 230 °C adn 300 °C, preferably between 240 °C and 280 °C.

Generally, the olefin polymers that can be used in the process of the present invention for the production of thermoweldable fibers are polymers or copolymers, and their mixtures, of R-CH = CH_2 olefins where R is a hydrogen atom or a C_1-C_6 alkyl radical. Particularly preferred are the following polymers:

1) isotactic or mainly isotactic propylene homopolymers.

2) crystalline copolymers of propylene with ethylene and/or C_4-C_8 alpha-olefins, such as for example 1-butene, 1-hexene, 1-octene, 4-methyl-1-pentene, wherein the total comonomer content ranges from 0.05% to 20% by weight, or mixtures of said copolymers with isotactic or mainly isotactic propylene homopolymers ;

3) heterophasic copolymers comprising (A) a propylene homopolymer and/or one of the copolymers of item 2), and an elastomeric fraction (B) comprising copolymers of ethylene with propylene and/or a C_4-C_8 alpha-olefin, optionally containing minor quantities of a diene, such as butadiene, 1,4-hexadiene, 1,5-hexadiene, ethylidene-1-norbornene.

Preferably the amount of diene in (B) is from 1% to 10% by weight.

The heterophasic copolymers (3) are prepared according to known methods by mixing the components in the molten state, or by sequential copolymerization, and generally contain the copolymer fraction (B) in quantities ranging from 5% to 80% by weight.

Specific examples of olefin polymers particularly suitable for the preparation of thermoweldable fibers are the following propylene random copolymers:

a) crystalline propylene random copolymers containing from 1.5% to 20% by weight of ethylene or C_4-C_8 alpha-olefins;

b) crystalline propylene random copolymers containing from 85% to 96% by weight of propylene, from 1.5% to 5% by weight of ethylene, and from 2.5% to 10% by weight of a C_4-C_8 alpha- olefin;

c) crystalline propylene random copolymers compositions comprising (percentages by weight):

(1) from 30% to 65% of a copolymer of propylene with a C_4-C_8 alpha-olefin, containing from 80% to 98% of propylene; and

(2) from 35% to 70% of a propylene copolymer with ethylene, and optionally with a C_4-C_8 alpha-olefin in quantity ranging from 2% to 10%; said copolymer containing from 2% to 10% of ethylene when the above mentioned C_4-C_8 alpha-olefin is not present, and from 0.5% to 5% of ethylene when the C_4-C_8 alpha-olefin is present;

d) compositions of crystalline propylene random copolymers and crystalline ethylene copolymers comprising (percentages by weight):

(1) from 40% to 70% of one or more crystalline propylene copolymers with one or more comonomers selected from ethylene and/or C_4-C_8 alpha-olefin, wherein the comonomer or comonomers content is from 5% to 20%;

(2) from 30% to 60% of LLDPE having a MFR E (according to ASTM D 1238) from 0.1 to 15.

The above mentioned copolymers can also be used mixed with each other and/or with isotactic or mainly isotactic propylene homopolymers.

Other specific examples of olefin polymers particularly suitable for the preparation of thermoweldable fibers are heterophasic copolymers comprising from 5% to 95% by weight of an isotactic or mainly isotactic propylene homopolymer, and/or a random propylene copolymer of the above mentioned types from a) to d), and from 95% to 5% by weight of a composition selected from:

(I) a composition comprising:

(i) 10-60 parts by weight of propylene homopolymer with an isotactic index higher than 90, or of a crystalline copolymer of propylene with ethylene and/or another C_4-C_8 alpha-olefin, containing over 85% by weight of propylene, and having an isotactic index higher than 85;

(ii) 10-40 parts by weight of a crystalline polymer fraction containing ethylene, insoluble in xylene at ambient temperature;

(iii) 30-60 parts by weight of an amorphous ethylenepropylene copolymer fraction optionally containing minor portions of a diene, soluble in xylene at ambient temperature and containing from 40 to 70% by weight of ethylene;

(II) a composition comprising:

(i) 10-50 parts by weight of propylene homopolymer with an isotactic index higher than 80, or a copolymer of propylene with ethylene and/or a C_4-C_8 alpha-olefin containing over 85% by weight of propylene;

(ii) 5-20 parts by weight of a copolymer fraction containing ethylene, insoluble in xylene at ambient temperature;

(iii) 40-80 parts by weight of a copolymer fraction of ethylene with propylene and/or a C_4-C_8 alpha-olefin, and optionally with minor portions of diene, containing less than 40% by weight of ethylene, said fraction being soluble in xylene at ambient temperature, and having an intrinsic viscosity ranging from 1.5 to 4 dl/g.

Specific examples of C_4-C_8 alpha olefins and dienes have been given above.

Generally, when used in the production of staple fibers the above mentioned olefin polymers have a Melt Flow Rate (MFR), determined according to ASTM D 1238-L, ranging from 0.5 to 100 g/10 min., preferably from 1.5 to 35 g/10 min..

When used in the spun-bonding apparatuses with the process of the present invention, the above mentioned olefin polymers have preferably a MFR value between 5 and 25 g/10 min., in particular from 8 to 15 g/10 min.. These values of MFR constitute an additional distinctive feature of the process of the invention, because in conventional spun-bonding processes polyolefins have a MFR greater than 25 g/10 min.

The above said values of MFR are obtained directly in polymerization, or by controlled degradation. In order to obtain said controlled degradation one adds, for example, organic peroxides in the spinning line or in the preceding steps of pelletization of the olefin polymers. Olefin polymers are generally used in the form of pellets or nonextruded particles, such as flakes or spheres, for example.

Preferably the olefin polymers which are subjected to spinning with either process of the present invention are stabilized with the types and quantities of stabilizers described in published European patent application 391438. According to said patent application the polyolefins to be used for spinning contain one or more of the following stabilizers:

a) from 0.01 to 0.5% by weight of one or more organic phosphites and/or phosphonites;

b) from 0.005 to 0.5% by weight of one or more HALS (Hindered Amine Light Stabilizer);

and optionally one or more phenolic antioxidants in concentration which does not exceed 0.02% by weight.

The above stabilizers can be added to the polyolefins by means of pelletization or surface coating, or they can be mechanically mixed with the polyolefins.

Specific examples of phosphites are:
tris(2,4-di-tert-butylphenyl)phosphite marketed by CIBA GEIGY under the trademark Irgafos 168; distearyl pentaerythritol diphosphite marketed by BORG-WARNER CHEMICAL under the trademark Weston 618; 4,4'-butylidenebis(3-methyl-6-tert-butylphenyl-di-tridecyl)phosphite marketed by ADEKA ARGUS CHEMICAL under the trademark Mark P; tris(monononyl phenyl)phosphite; bis(2,4-di-tert-butyl)-pentaerythritol diphosphite, marketed by BORG-WARNER CHEMICAL under the trademark Ultranox 626.

A preferred example of phosphonites is the tetrakis(2,4-di-tert-butylphenyl)4,4'-diphenylilenediphosphonite, on which Sandostab P-EPQ, marketed by Sandoz, is based.

The HALS are monomeric or oligomeric compounds containing in the molecule one or more substituted amine, preferably piperidine, groups.

Specific examples of HALS containing substituted piperidine groups are the compounds sold by CIBA-GEIGY under the following trademarks:

Chimassorb	944
Chimassorb	905
Tinuvin	770
Tinuvin	292
Tinuvin	622
Tinuvin	144
Spinuvex	A36

and the product sold by American CYANAMID under the mark Cyasorb UV 3346.

Examples of phenolic antioxidants are: tris-(4-tert-butyl-3-hydroxy-2,6-dimethylbenzyl)-s-triazine-2-4-6-(1H,3H,5H)-trione, marketed by American CYANAMID under the trademark Cyanox 1790; calcium bi-[monoethyl(3,5-di-tert-butyl-4-hydroxy-benzyl)phosphonate];1,3,5-tris(3,5-di-tert-butyl-4-hydroxybenzyl)-s-triazine-2,4,6(1H,3H,5H)trione; 1,3,5-trimethyl-2,4,6-tris(3,5-di-tert-butyl-4-hydroxybenzyl)benzene; pentaerythrityl-tetrakis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate]; octadecyl 3-(3,5-di-tert-butyl-4-hydroxyphenyl)-propionate, marketed by CIBA GEIGY under the trademarks Irganox 1425; Irganox 3114; Irganox 1330, Irganox 1010, Irganox 1076 respectively; 2,6-dimethyl-3-hydroxy-4-tert-butyl benzyl abietate.

The following examples are given in order to illustrate and not limit the present invention.

EVALUATION OF THE THERMOWELDABILITY OF THE FIBERS

Generally, in order to evaluate the thermoweldability of fibers, a nonwoven fabric is prepared from the fiber being tested by calendering under certain given conditions. Subsequently, the tension needed to tear said nonwoven fabric both in the direction parallel and transversal to the calendering is measured.

The tension value determined in this fashion is considered a measure of the fiber thermowelding capability.

The result, however, is influenced substantially by the finishing characteristics of the fibers (crimping, surface finishing, thermosetting, etc.), and by the homogeneity of distribution of the fibers entering the calender. To avoid these inconveniences and obtain a more direct evaluation of the fiber thermoweldability characteristics a method has been perfected that will be described below.

Specimens are prepared from a 400 tex roving (method ASTM D 1577-7) 0.4 meter long, made up of continuous fibers.

After the roving has been twisted eighty times, the two extremities are united, thus obtaining a product where the two halves of the roving are entwined as in a rope.

The thermowelding is carried out on said specimen using a Bruggel HSC-ETK thermowelding machine, operating at a plate temperature of 150°C, using a clamping pressure of 800 N and 1 second welding times.

A dynamometer is used to measure the average strength required to separate the two halves of the roving which constitute each specimen at the thermowelding point. The result, expressed in Newton, is obtained by averaging out at least eight measurements, and represents the thermowelding strength of the fibers.

POLYMERS SUBJECTED TO SPINNING

The polymers used in the examples to produce the fibers are the following:

Polypropylene I

Mechanical mixture of propylene homopolymer having MFRL of 13 g/10 min and a fraction soluble in xylene at 25°C equal to 3.5% by weight, in the form of flakes with a controlled particle size distribution (average diameter of the particles 450µm), containing:

additive	concentration (by weight)
Irganox 1076	0.01%
Irganox 3114	0.01%
Irgafos 168	0.07%
Calcium stearate	0.05%

Said mechanical mixture has been obtained by introducing the components into a CACCIA speed mixer model LABO 30, and mixing for 4 minutes at 1400 rpm.

Polypropylene II

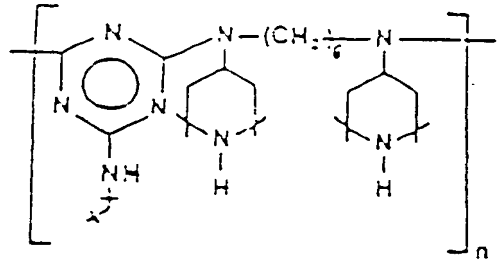
Same composition as for Polypropylene I, but in the form of pellets, as the above said mechanical mixture has been granulated by extrusion.

Polypropylene III

Propylene homopolymer in spheroidal particle form with a diameter ranging from 2 to 3 mm, having a MFR of 12.2 g/10 min. and a fraction soluble in xylene at 25°C equal to 4.2% by weight, surface additivated with:

additive	concentration (by weight)
Irganox 1076	0.01%
Chimassorb 994	0.02%
Sandostab P-EPQ	0.05%
Calcium stearate	0.05%

The Chimassorb 944 is a HALS having the formula



wherein n generally ranges from 2 to 20.

Example 1

Using the above defined polypropylene I, staple fibers are prepared on a LEONARD 25 long spinning apparatus, built and marketed by Costruzioni Meccaniche Leonard - Sumirago (VA) - Italy. The set-up of the apparatus is as follows:

- extruder with a screw having a 25 mm diameter and a length/diameter ratio of 25, and a flow-rate ranging from 1 to 6 Kg/h;
- 2.5 cm^3/rev. metering pump;
- die having 61 round holes with an output diameter of 0.8 mm;
- cooling system for the extruded filaments by means of transversal air jet at 18-20 °C;
- gathering apparatus with a speed ranging from 1000-6000 m/min.;
- drawing apparatus in steam oven.

The following process conditions are used for the spinning operation:

- die temperature	280 °C
- hole flow rate	0.3 g/min.
- gathering speed	1400 m/min.
- draw ratio	1.3
- draw temperature	100 °C

The characteristics of the fibers obtained in this manner are:

- single fiber count (according to ASTM D 1577-79)	1.7 dtex
- weldability	4.1 N

Comparative example 1

The same polymer, apparatus and conditions of Example 1 are used, except that the die has 61 round holes and the output diameter is 0.4 mm.

The characteristics of the fibers obtained in this manner are:

- single fiber count	1.7 dtex
- weldability	2.0 N

Example 2

Using the above defined polypropylene I, staple fibers with a short-spinning pilot apparatus set up as follows are prepared:

- single-screw extruder with a 120mm diameter and a length equal to 30 diameters;

- 150 cm^3/rev. metering pump;
- die with 3.5×10^4 round holes and a 0.6 mm output diameter; said holes being situated in the form of a crown;
- cooling device, coaxial to the crown of holes of the die, emitting 20°C air on a plane perpendicular to the exiting fibers.

The spinning conditions are as follows:

- temperature	300°C
- hole flow rate	0.018 g/min.
- distance between the die and cooling airflow	5 mm
- gathering speed	70 m/min.
- draw temperature	80°C
- draw ratio	1.4

The characteristics of the fibers obtained in this manner are:

- single fiber count	2.3 dtex
- weldability	6.85 N

Example 3

The same apparatus and conditions of Example 2 are used to produce staple fibers, except that one uses the polypropylene III.

The characteristics of the fibers obtained in this manner are:

- single fiber count	2.3 dtex
- weldability	6.5 N

Example 4

Staple fibers are produced using the same polymer, apparatus and conditions of Example 2, except that the distance between the die and the cooling airflow is 15 mm.

The characteristics of the fibers obtained in this manner are:

- single fiber count	2.3 dtex
- weldability	7.6 N

Example 5

Staple fibers are produced using the same polymer, apparatus and conditions of Example 2, except that the drawing occurs at ambient temperature.

The characteristics of the fibers obtained in this manner are:

- single fiber count	2.3 dtex
- weldability	10 N

Comparative example 2

Staple fibers are produced using the same polymer of Example 2, an industrial apparatus made up of 8 spinning units identical to the one described in Example 2, but whose dies have 5.18×10^4 round holes having a output diameter of 0.4 mm. The spinning conditions are:

- temperature	285 °C
- hole flow rate	0.018 g/min.
- distance between the die and cooling airflow	5 mm
- gathering speed	64 m/min.
- draw temperature	80 °C
- draw ratio	1.5

The characteristics of the fibers obtained in this manner are:

- single fiber count	2.3 dtex
- weldability	2.35 N

Comparative example 3

The same apparatus and conditions of Comparative example 2 are used to produce staple fibers, except that polypropylene III is used.

The spinning conditions are:

- temperature	295 °C
- hole draw ratio	0.024 g/min.
- distance between the die and cooling airflow	5 mm
- gathering speed	70 m/min.
- draw temperature	80 °C
- draw ratio	1.35

The characteristics of the fibers obtained in this manner are:

- single fiber count	2.3 dtex
- weldability	2.2 N

Example 6

Using polypropylene I, fibers are prepared using a BARMAG 25 mod. 2E1/24D apparatus for spunbonding, manufactured and sold by BARMER MASHINENFABRIK A.G. Manufacture. The lay out of the apparatus is as follows:

- an extruder with a screw 25 mm in diameter and a ratio lenght/diameter of 24; the extruder has a flow rate between 0.3 and 1.2 kg/hr;
- a metering pump of 0.6 cm^3/rev.
- a die with 37 holes of circular section having a output hole diameter of 0.8 mm;
- a cooling system for the extruded fibers by transverse air jet at 18-20 °C;
- an air suction gathering device using a Venturi tube, with a gathering speed ranging between 500-4000 m/min.

The process conditions for spinning are as follows:

- die temperature - hole flow rate - gathering speed - distance between the die and and the cooling air jet.	280 °C 0.6 g/min. 2700 m/min. 20 mm

The characteristics of the obtained fibers are:

- single fiber count - weldability	2.2 dtex 5.4 N

Comparison example 4

The same polymer is used, with the same apparatus and working under the same conditions as in Example 6, except that the die has 37 circular section holes with a output hole diameter of 0.4 mm. The characteristics of the obtained fibers are:

- single fiber count - weldability	2.2 dtex 2.04 N

Example 7

Using polypropylene II, fibers and nonwoven fabrics are prepared with a pilot appartus for spun-bonding made by the German company LURGI. The layout of the apparatus is as follows:

- rectangular dies containing 931 holes of circular section and with a output hole diameter of 0.9 mm.
- an air cooling device at 20 °C, acting on a plane perpendicular to the emergent fibers.

The spinning conditions are as follows:

- temperature - hole flow rate - distance between the die and the cooling air flow - gathering speed	280 °C 0.52 g/min. 30 mm 2300 m/min.

The fibers obtained under these conditions have the following characteristics:

- single fiber count - weldability	2.3 dtex 6.4 N

Example 8

Fibers are produced with the same apparatus and working under the same conditions as in Example 6, but using polypropylene III. The obtained fibers have the following characteristics:

- single fiber count - weldability	2.2 dtex 5.8 N

Comparison Example 5

Fibers are produced with the same polymer used in Example 8, and the same apparatus used in Example 6, but the die contains 37 holes of circular section and the output hole diameter is equal to 0.4 mm.
The obtained fibers have the following characteristics:

- single fiber count	2.2 dtex
- weldability	2.1 N

Claims

1. A process for the preparation of thermoweldable polyolefin fibers, wherein the dies used have a real or equivalent output diameter of the holes greater than or equal to 0.5 mm, with the proviso that for fibers having a count greater than or equal to 4 dtex, the ratio of the said output diameter of the holes to the count is greater than or equal to 0.06 mm/dtex.

2. The process of claim 1, wherein the real or equivalent output diameter of the holes ranges from 0.5 to 2 mm.

3. The process of claim 1, wherein the operation is carried out using a long-spinning apparatus for staple fibers.

4. The process of claim 3, wherein the hole flow rate ranges from 0.15 to 1 g/min., the fiber gathering speed ranges from 500 to 3500 m/min and the draw ratio ranges from 1.1 to 4.0.

5. The process of claim 1, wherein the operation is carried out using a short-spinning apparatus for staple fibers.

6. The process of claim 5, wherein the hole flow rate ranges from 0.005 to 0.18 g/min., the fiber gathering speed ranges from 30 to 500 m/min and the draw ratio ranges from 1.10 to 3.50.

7. The process of claim 5, wherein the cooling space is greater than 2 mm.

8. The process of claim 5, wherein the draw temperature used is lower than 100 °C.

9. The process of claim 1, wherein the operation is carried out using a spun-bonding apparatus.

10. The process of claim 9 wherein the hole flow rate ranges from 0.1 to 2.0 g min. and the fiber gathering speed ranges from 400 to 4500 m/min.

11. The process of claim 10, wherein the cooling space is greater than 2 mm.

12. The process of claim 9, wherein the olefin polymers subjected to spinning have a MFR from 5 to 25 g/10 min..

13. The process of claim 1, wherein the olefin polymers subjected to spinning are selected from:
1) isotactic, or mainly isotactic propylene homopolymers;
2) crystalline copolymers of propylene with ethylene and/or C_4-C_8 alpha-olefins wherein the total comonomer content ranges from 0.05% to 20% by weight, or mixtures of said copolymers with isotactic or mainly isotactic propylene homopolymers;
3) heterophasic copolymers comprising (A) a propylene homopolymer and/or one of the copolymers of item 2), and an elastomeric fraction (B) comprising copolymers of ethylene with propylene and/or a C_4-C_8 alpha-olefin, optionally containing minor quantities of a diene.

14. The process of claim 1, wherein the olefin polymers subjected to spinning contain one or more of the following stabilizers:

a) from 0.01 to 0.5% by weight of one or more organic phosphites and/or phosphonites;

b) from 0.005 to 0.5% by weight of one or more HALS;

and optionally one or more phenolic antioxidants in concentrations which do not exceed 0.02% by weight.

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(54) **Spinning process for the preparation of high thermoweldability polyolefin fibers.**

(57) Disclosed are polyolefin fibers, for the preparation of nonwoven fabrics, prepared by using dies having a real or equivalent output diameter of the holes greater than or equal to 0.5 mm, with the proviso that for fibers having a count greater than or equal to 4 dtex, the ratio of the said output hole diameter to the count is greater than or equal to 0.06 mm/dtex.

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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X Y	US-A-4 211 819 (KOHICHI KUNIMUNE ET AL.) * column 4, line 11 - line 38; claims 1-3; examples 1-6 * ---	1-4,9-13 14	D01F6/06 D01F6/30 D01F6/46 D04H1/54
D,A Y	EP-A-0 391 438 (HIMONT INCORPORATED) * the whole document * * claims * ---	1-14 14	
P,A	EP-A-0 552 013 (HERCULES INCORPORATED) * the whole document * -----	1-14	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

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D04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 May 1995	Tarrida Torrell, J

CATEGORY OF CITED DOCUMENTS

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